

## 2. MANAGEMENT MEASURE CATEGORIES

### 2.1 Agriculture

#### 2.1.1 Introduction

The California State Water Resources Control Board (SWRCB), California Coastal Commission (CCC), and other state agencies have identified seven management measures to address agricultural nonpoint source (NPS) pollution of State waters. The management measures consist of a suite of plans, practices, technologies, operating methods, or other alternatives that may be used in combination to control NPS pollution. Associated with each management measure are management practices that are designed to reduce the quantities of pollutants entering receiving waters. Many of the practices listed under each management measure were approved for use by the California Natural Resources Conservation Service (NRCS). Some practices are recommended by the U.S. Department of Agriculture (USDA) NRCS as components of Resource Management Systems (RMSs). RMSs, also known as conservation planning, are whole-farm plans that incorporate economic, social, and ecological considerations to meet the demands of crop and animal production and long-term environmental sustainability. RMSs contain pollution control criteria for soil, air, water, plant, animal, and human resources, which are described in the USDA NRCS *Field Office Technical Guide*. Not all components of RMSs are included in the management measures and practices—only those that are related to water quality. The fact sheet prepared for each management measure informs readers of the programs, resources, and case studies specific to California and the management measure.

#### Agriculture Category Links:

- [Erosion and Sediment Control](#)
- [Facility Wastewater and Runoff from Confined Animal Facilities That Are Not CAFOs](#)
- [Nutrient Management](#)
- [Pesticide Management](#)
- [Grazing Management](#)
- [Irrigation Water Management](#)
- [Education/Outreach](#)

The NPS pollutants typically associated with agriculture are nutrients, animal waste, sediments, and pesticides. Agricultural NPS pollution enters receiving waters by direct runoff to surface waters or seepage to ground water. Runoff of nutrients can result from excessive application of fertilizers and animal waste to land, and from improper storage of animal waste. Farming activities can cause excessive erosion, which results in sediment entering receiving waters. Improper use and overapplication of pesticides causes pesticide pollution. Improper grazing management can cause erosion, soil compaction, and excessive nutrients, all of which impair sensitive areas. Overapplication of irrigation water can cause runoff of sediments and pesticides to enter surface water or seep into ground water. Sediment, pesticides, and excess nutrients all affect aquatic habitats by causing eutrophication, turbidity, temperature increases, toxicity, and decreased oxygen.

Programs established to control NPS pollution from agriculture in California include joint efforts by local, State, and federal agencies. The SWRCB and the CCC oversee the statewide program, with assistance from the Department of Pesticide Regulation for pesticide pollution and the Department of Water Resources for irrigation water management. Local governments administer programs for general planning and local coastal plans. The California NRCS and the University of California Cooperative Extension Service provide technical and financial services for farmers. Resource Conservation Districts also provide

guidance, training, and technical assistance. The programs administered by these various agencies are listed under the Programs heading in each fact sheet; sources of information specific to each management measure are listed under Information Resources.

The California *Management Measures for Polluted Runoff* defines the seven agriculture management measures as follows:

- **1A. Erosion and Sediment Control.** Management Measure 1A addresses NPS problems associated with soil erosion and sedimentation. Where erosion and sedimentation from agricultural lands affects coastal waters and/or water bodies listed as impaired by sediment, landowners must design and install or apply a combination of practices to reduce solids and associated pollutants in runoff during all but the larger storms. Alternatively, landowners may apply the erosion component of an RMS as defined in the USDA NRCS *Field Office Technical Guide*, which contains standards and specifications for installing these practices.
- **1B. Facility Wastewater and Runoff from Confined Animal Facilities That Are Not CAFOs.** Pursuant to Management Measure 1B, facility wastewater and contaminated runoff from confined animal facilities that are not CAFOs must be contained at all times. Storage facilities should be of adequate capacity to allow for proper wastewater use and should be constructed so they prevent seepage to ground water, and stored runoff and accumulated solids from the facility should be managed through a waste use system that is consistent with Management Measure 1C or removed from the site.
- **1C. Nutrient Management.** Management Measure 1C addresses the development and implementation of comprehensive nutrient management plans for areas where nutrient runoff is a problem affecting coastal waters and/or water bodies listed as impaired by nutrients. Such plans would include a plant tissue analysis to determine crop nutrient needs; crop nutrient budget; identification of the types, amounts, and timing of nutrients necessary to produce a crop based on realistic crop yield expectations; identification of hazards to the site and adjacent environment; soil sampling and tests to determine crop nutrient needs; and proper calibration of nutrient equipment. When manure from confined animal facilities that are not CAFOs is to be used as a soil amendment and/or is disposed of on land, the plan should discuss steps to ensure that subsequent irrigation of that land does not leach excess nutrients to surface or ground water.
- **1D. Pesticide Management.** Management Measure 1D is intended to reduce contamination of surface water and ground water from pesticides. Implementation of this measure will primarily occur through cooperation with the Department of Pesticide Regulation as provided in a Management Agency Agreement with the SWRCB. Elements of this measure include development and adoption of reduced risk pest management strategies (including reductions in pesticide use); evaluation of pest, crop, and field factors; use of Integrated Pest Management (IPM); consideration of environmental impacts in choice of pesticides; calibration of equipment; and use of anti-backflow devices. IPM is a key component of pest control. IPM strategies include evaluating pest problems in relation to cropping history and previous pest control measures, and applying pesticides only when an economic benefit will be achieved. When used, pesticides should be selected based on their effectiveness to control target pests and environmental impacts such as their persistence, toxicity, and leaching potential.
- **1E. Grazing Management.** Management Measure 1E is intended to protect sensitive areas (including streambanks, lakes, wetlands, estuaries, and riparian zones) by reducing direct loadings of animal wastes and sediment. This may include restricting or rotationally grazing livestock in sensitive areas by providing fencing and livestock stream crossings, and by locating salt, shade, and alternative drinking sources away from sensitive areas. Upland erosion can be reduced by, among other methods, (1) maintaining the land consistent with the California

Rangeland Water Quality Management Plan or Bureau of Land Management and USDA Forest Service activity plans or (2) applying the range and pasture components of a Resource Management System (USDA NRCS *Field Office Technical Guide*). This may include prescribed grazing, seeding, gully erosion control such as grade stabilization structures and ponds, and other critical area treatment.

- **IF. Irrigation Water Management.** Management Measure 1F promotes effective irrigation while reducing pollutant delivery to surface and ground waters. Pursuant to this measure, irrigation water would be applied uniformly based on an accurate measurement of cropwater needs and the volume of irrigation water applied, considering limitations raised by such issues as water rights, pollutant concentrations, water delivery restrictions, salt control, wetland, water supply, and frost/freeze temperature management. Additional precautions would apply when chemicals are applied through irrigation.
- **1G. Education/Outreach.** The goals of Management Measure 1G are to implement pollution prevention and education programs to reduce NPS pollutants generated by the following activities, where applicable:
  - Activities that cause erosion and loss of sediment on agricultural land and land that is converted from other land uses to agricultural land;
  - Activities that cause discharge from confined animal facilities (excluding CAFOs) to surface waters;
  - Activities that cause excess delivery of nutrients and/or leaching of nutrients;
  - Activities that cause contamination of surface water and ground water from pesticides;
  - Grazing activities that cause physical disturbance to sensitive areas and the discharge of sediment, animal waste, nutrients, and chemicals to surface and ground waters;
  - Irrigation activities that cause NPS pollution of surface waters.

## 2.1.2 General Resources

There are several federal and State agencies and programs that can provide general information to promote sustainable agriculture and prevent NPS pollution from entering receiving waters. The agencies and programs listed below can provide assistance and information for all seven management measures. Resources specific to each of the seven agriculture management measures can be found on the corresponding fact sheet.

- **University of California Cooperative Extension Service** (<http://ucanr.org/CES.CEA.shtml>): The Cooperative Extension Service has 50 offices in California with experienced staff to provide technical assistance to landowners on farm management and environmental protection. Local cooperative extension service offices can provide specific, local information on programs and information resources available to address many of the agriculture management measures.
- **California NRCS** (<http://www.ca.nrcs.usda.gov/>): For local assistance, contact USDA NRCS California State Office, 430 G Street #4164, Davis, CA 95616-4164 (Telephone: 530-792-5600; Fax: 530-792-5790). The California NRCS works with landowners and provides technical and financial assistance to conserve natural resources on private lands. In California, assistance is provided to land users through cooperative partnerships with more than 100 Resource Conservation Districts and other agencies and organizations. Soil and resource conservationists, soil scientists, agronomists, foresters, wildlife biologists, engineers, water quality specialists, information specialists, and other resource management professionals work together to address

locally identified and nationally prioritized conservation issues. County USDA NRCS offices can provide specific, local information on programs and information resource available to address many of agriculture management measures. Use the Web site listed above to locate the USDA NRCS office for each county.

- **California Department of Food and Agriculture, Office of Agriculture and Environmental Stewardship** (<http://www.cdfa.ca.gov/exec/aep/aes/index.htm>): This office identifies and prioritizes environmental conservation and protection issues related to agriculture and provides the agricultural community and the general public with accurate and timely information as well as technical support to identify, develop, and implement actions that enhance environmental conservation and protection.
- **California Association of Resource Conservation Districts** (<http://www.carcd.org/>): Resource Conservation Districts (RCDs) are special districts of the State of California, set up under California law to be locally governed agencies with their own locally appointed, independent boards of directors. RCDs implement projects on private and public lands and educate landowners about resource conservation. Each RCD can provide local information on project and programs to control agricultural NPS pollution. The California Association of Resource Conservation District's Web site provides a link to each RCD. The California Association of Resource Conservation Districts is a voluntary association whose primary purpose is to provide a unified means for California RCDs to meet major conservation goals.
- **USDA NRCS Electronic *Field Office Technical Guide*** (<http://www.nrcs.usda.gov/technical/efotg/>): Technical guides are the primary technical references for USDA NRCS. They contain technical information about the conservation of soil, water, air, and related plant and animal resources. Technical guides used in each field office are localized so that they apply specifically to the geographic area for which they are prepared. These documents are referred to as *Field Office Technical Guides* (FOTGs). The FOTG is maintained in each USDA NRCS field office as a compilation of technical knowledge, resource data references, and conservation practice standards. Click on California for a direct link to the California FOTG.
- **USDA NRCS, CORE4 *Conservation Practices Training Guide*** (<http://www.nrcs.usda.gov/technical/ECS/agronomy/core4.pdf>): The purpose of this workbook is to enhance the technical knowledge of USDA NRCS personnel and their colleagues in both the public and private sector and to assist them in helping landowners effectively use conservation tillage, nutrient management, pest management, and conservation buffers.
- **USEPA, *National Management Measures to Control Nonpoint Source Pollution from Agriculture*** (<http://www.epa.gov/owow/nps/agmm/>): This is a technical guidance and reference document for use by state, local, and tribal managers in the implementation of NPS pollution management programs. It contains information on the best available, economically achievable means of reducing pollution of surface and ground water from agriculture.
- **USEPA, National Agriculture Compliance Assistance Center** (<http://www.epa.gov/agriculture/index.html>): The National Agriculture Compliance Assistance Center (the Ag Center) provides information about environmental requirements that affect the agricultural community. The USEPA, with the support of USDA, created the Ag Center.
- **Livestock and Poultry Environmental Stewardship Curriculum** (<http://www.lpes.org/>): This project delivers a national curriculum and supporting educational tools to U.S. livestock and poultry industry advisors, who help producers acquire certification and achieve environmentally sustainable production systems. Producers will also benefit directly from the information and assessment tools that the curriculum provides.

- **University of California Conservation Tillage Workgroup** (<http://groups.ucanr.org/ucct/>). The Conservation Tillage Workgroup's goal is to provide up-to-date information on research and education activities related to conservation tillage production systems in California. The Conservation Tillage Workgroup currently consists of more than 80 University of California Cooperative Extension, Agricultural Experiment Station, USDA Agricultural Research Service and Natural Resource Conservation Service, private industry, farmer and student members and affiliates. The Workgroup conducts a wide range of research studies, demonstration evaluations and conferences throughout California.
- **USDA, Economic Research Service (ERS)** (<http://www.ers.usda.gov/>): This Web site provides information on agriculture-related policy and conservation programs, among other topics. The "Natural Resources, Environment, and Conservation" key topic includes such subject areas as irrigation and water use, manure management, soil conservation, water quality, and wetlands. Resources include online publications and data products.
- **USEPA, BASINS: Better Assessment Science Integrating Point and Nonpoint Sources** (<http://www.epa.gov/waterscience/basins/>): This tool, used for managing watersheds, integrates national watershed data and state-of-the-art environmental assessment and modeling tools into a geographic information system. The EPA Web site allows users to download the application and access documentation, metadata, frequently asked questions, training, an online forum, and other tools and utilities.
- **USEPA, Nonpoint Source News-Notes** (<http://www.epa.gov/owow/info/NewsNotes/>): Nonpoint Source News-Notes is an online bulletin published by EPA that covers a wide range of topics, including nonpoint source pollution control, watershed restoration, and ecosystem-driven management. The Web interface allows users to search current and back issues of News-Notes by keyword.
- **Water Quality Information Center at the National Agricultural Library** (<http://grande.nal.usda.gov/wqic>): This is a central clearinghouse of more than 1,700 electronic documents related to water and agriculture. Document categories include decision-making technology; laws, legislature, and regulations; pollution; irrigation; nutrient management; and conservation-based management. The site also features a search function to find publications using keywords.
- **G. Fred Lee and Associates, Stormwater Runoff Science/Engineering Newsletter** (<http://www.gfredlee.com/newsindex.htm>): This newsletter is devoted to stormwater-runoff water quality issues in managing urban and agricultural stormwater runoff water quality impacts. The newsletter can be searched by topic or volume, and publications on other topics, including landfills, watersheds, contaminated sediment, reclaimed waters, hazardous chemicals, water quality, domestic water, and excess fertilization, can also be found on this site.



**Fact Sheet Links:**

- [Programs](#)
- [Management Practices](#)
- [Information Resources](#)
- [Case Studies](#)
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### 2.1.3 Management Measure 1A Erosion and Sediment Control

#### *Management Measure*

Apply the erosion component of a conservation management system (CMS) as defined in the *Field Office Technical Guide* of the U.S. Department of Agriculture's Natural Resources Conservation Service (USDA NRCS) to minimize the delivery of sediment from agricultural lands to surface waters, or design and install a combination of management and physical practices to settle the settleable solids and associated pollutants in runoff delivered from the contributing area for storms of up to a 25-year, 24-hour frequency.

#### 2.1.3.1 Programs

- The Sonoma County Agricultural Commission, Agriculture Division, administers the Sonoma County Vineyard Erosion and Sediment Control Ordinance. Growers planting new vineyards or replanting existing vineyards are required to use recognized conservation practices, and management practices and provide for riparian setback to protect the environment and watersheds of the county ([http://www.sonoma-county.org/agcomm/ag\\_division.htm](http://www.sonoma-county.org/agcomm/ag_division.htm) ).
- The California Tahoe Conservancy has undertaken a comprehensive program to reduce the sources of soil erosion and the amount of sediment and algae-encouraging nutrients that reach Lake Tahoe ([http://www.tahoicons.ca.gov/programs/soil/prg\\_soil.html](http://www.tahoicons.ca.gov/programs/soil/prg_soil.html)).

#### 2.1.3.2 Management Practices

The purpose of this management measure is to prevent and reduce the amount of soil entering surface water. California-approved USDA NRCS standards and practices should be used to prevent and reduce erosion on the field or to trap and settle sediment at the edge of the field. Strategies used to control rill and sheet erosion, streambank erosion, soil mass movement, and irrigation-induced erosion should be used as required in the erosion component of a conservation management system (CMS). Recommended practices include the following:

- Erosion can be reduced or prevented by leaving crop residues on the field, planting cover crops or other vegetative cover, and applying mulch to bare fields. In addition, fields can be graded to reduce slope length, steepness, or unsheltered distance (i.e., contour farming), and terraces and diversions can be used to reduce slope length. Finally, cross-wind strips can be installed and hedgerows, trees, and shrubs can be maintained along edges of fields or against prevailing winds to prevent wind erosion.
- Soil quality can be maintained through crop rotation, which involves planting crops in a recurring sequence on the same field, and by using conservation tillage to improve soil properties and improve water infiltration.
- Eroded sediment and associated pollutants can be trapped before leaving the site by installing filter strips, field borders, fiber mats, and buffers to filter and trap sediment. Grassed waterways can be installed to prevent gullies and to filter and trap sediment, and sediment ponds, basins, and traps can be used to treat sediment-laden runoff.

- Techniques such as prescribed [grazing](#), designated animal crossings over streams, and exclusion of animals from streambanks can prevent excessive erosion of fields and riparian areas from hoof traffic.
- [Irrigation management techniques](#) can be used to control erosion caused by irrigation.

### 2.1.3.3 Information Resources

- **The Wine Institute** ([http://www.wineinstitute.org/communications/highlight/hom\\_1jan02.htm](http://www.wineinstitute.org/communications/highlight/hom_1jan02.htm)): The Wine Institute provides information on sustainable winegrowing practices. This Web site features cover cropping and highlights the experiences and expertise of Trincherro Family Estates, Cinnabar Vineyards, and Winery and Domaine Chandon.
- **University of California, Davis, Cooperative Extension, Sample Erosion Control Plan for the XYZ Ranch** ([http://californiarangeland.ucdavis.edu/rwqp\\_files/sample\\_ECP.HTM](http://californiarangeland.ucdavis.edu/rwqp_files/sample_ECP.HTM)): This Web site features an erosion control plan that was submitted for several acres in the Garcia River. The plan identifies areas of sediment delivery, identifies areas at risk of sediment delivery, and presents a schedule to control all sediment delivery associated with past and present land management activities.
- **California Buffer Initiative: Common Sense Conservation** (<http://www.ca.nrcs.usda.gov/programs/buffer.html>): The Web site provides information and links on the initiative to create conservation buffers and filter strips in California.
- **USDA NRCS Conservation Buffers Initiative** (<http://www.nrcs.usda.gov/feature/buffers/>): This Web site provides information on buffers, how to use buffers, and technology specifications. It describes success stories, and provides links for more information.
- **CORE4, Crop Residue Management Facts** (<http://www.ctic.purdue.edu/Core4/CT/Definitions.html>): This fact sheet provides information on crop residue management and conservation tillage.
- **CORE4, Ten Benefits of Conservation Tillage** (<http://www.ctic.purdue.edu/Core4/CT/CTSurvey/10Benefits.html>): This fact sheets describes the 10 benefits of conservation tillage.
- **University of Illinois, College of Agriculture, Cooperative Extension Service, 60 Ways Farmers Can Protect Their Surface Water** (<http://www.thisland.uiuc.edu/60ways/60ways.html>): This Web site includes information on managing surface cover on agricultural lands and controlling water flow on steep slopes.
- **Yolo County Resource Conservation District, Benefits from Row Crop Tailwater Ponds** (<http://www.yolored.org/ponds/tailwater/tailwater.shtml>).
- **Yolo County Resource Conservation District, Bring Farm Edges Back to Life** (<http://www.yolored.org/education/Farm Edges v5 excerpt 2.pdf>). This conservation guidebook provides information on managing unused farm areas to reduce erosion, enhance conservation, and manage pests and weeds.
- **Community Alliance with Family Farmers, Hedgerows for California Agriculture: A Resource Guide** (<http://www.caff.org/programs/farmscaping/Hedgerow.pdf>). This resource guidebooks includes information about using hedgerows and related practices as tools to increase groundcover and reduce soil erosion and to improve pesticide management. This guide includes information on the benefits of hedgerows, practical information about installing hedgerows, and other relevant reference materials.

### 2.1.3.4 Case Studies

*Protecting Hillsides and Fish Habitat at Navarro Vineyards.* The steep slopes of Anderson Valley in Mendocino County have some of the thinnest soils and heaviest rainfalls in California, averaging 40 to 90 inches annually. Controlling soil erosion is important for local vintners, including the husband-wife team of Ted Bennett and Deborah Cahn of Navarro Vineyards in Philo. Bennett and Cahn control erosion to help keep pollutants carried with sediment out of the fish habitat in the Navarro River. They mapped the property to determine the main watershed areas and then developed management practices for the vineyards and roads—critical areas that are often conduits for runoff.

Each year the winery regrades the roads on a slant to direct the water flow to the inside slope. As the water runs down the inside channel, it falls into one of 60 stone drop boxes that catch the flow and divert it safely off the sides of the roads through underground culvert drains. Piles of rocks dissipate the impact of the water as it comes out of the culverts. The Navarro vineyard staff check the culverts after every big rain to clear any debris. The roads are also closed after a storm so that vehicles do not tear up the roads. The Navarro vineyard staff also maintain the roads by planting a ground cover of hydro-seed, a special slurry of straw, water, and grass seed, applied on the banks or potential erosion sites before the rains. They protect eroded areas with biodegradable material such as straw matting and coconut husks. Perennial grasses are grown in the waterways so that runoff will not form erosion gullies. In the vineyards, the staff composts and irrigates grass cover crops on all rows to help hold the soil in place during winter. Later, alternating rows are mowed and tilled or, in very steep areas, just mowed. Navarro is vigilant in keeping rodent populations in check, because rodent tunnels speed soil erosion ([http://www.wineinstitute.org/communications/highlight/hom\\_1oct02.htm](http://www.wineinstitute.org/communications/highlight/hom_1oct02.htm)).

*The California Integrated Waste Management Board (CIWMB).* The board has funded four erosion control and NPS pollution projects in California. Three of these projects involve commercial grape and citrus growers using mulch (<http://www.ciwmb.ca.gov/Organics/GreenTeam/Target6/ProjMap.htm>).

*California NRCS Buffer Initiative.* A vineyard owner in Napa Valley established 50- to 100-foot setbacks to protect streams from the effects of erosion and chemical application. The size of his vineyards was reduced in some cases by 10 percent, resulting in less revenue, but capital costs for stabilizing the stream periodically with riprap were eliminated. Establishment of the buffer contributed positively to water quality by visibly reducing the turbidity of the stream (<http://www.nrcs.usda.gov/feature/buffers/calif.html>).

*Agricultural Runoff Threatens Ocean Ecosystem.* A study by Stanford University scientists presents the first direct evidence linking large-scale coastal farming to massive algal blooms in the sea. Researchers used satellite imagery of Mexico's Gulf of California, also known as the Sea of Cortez, to demonstrate how agricultural runoff fuels algal blooms in vulnerable areas of the ocean. The Yaqui Valley agricultural area, which drains into the Gulf, was irrigated four times per year between 1998 and 2002; following each irrigation event, algal blooms appeared within days (<http://cesp.stanford.edu/news/467/>).

### 2.1.3.5 References

USDA. No date. *Electronic Field Office Technical Guide for California*. U.S. Department of Agriculture, Natural Resource Conservation Service. (<http://efotg.nrcs.usda.gov/>)

USEPA. 2002. Chapter 4: Management Measures. In *National Management Measures for the Control of Nonpoint Pollution from Agriculture*. U.S. Environmental Protection Agency, Washington, DC. (<http://www.epa.gov/owow/nps/agmm/>)



**Fact Sheet Links:**

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## 2.1.4 Management Measure 1B

### Facility Wastewater and Runoff from Confined Animal Facilities That Are Not CAFOs

#### *Management Measure*

Limit the discharge from the confined animal facility that is not a CAFO by:

1. Containing both facility wastewater and the contaminated runoff from confined animal facilities at all times, up to and including storms exceeding a 25-year, 24-hour frequency event [storage facilities should be of adequate capacity to allow for proper wastewater utilization and should be constructed so they prevent seepage to ground water]; and
2. Managing stored runoff and accumulated solids from the facility through an appropriate waste utilization system that is consistent with Management Measure 1C.

#### 2.1.4.1 Programs

- The California Dairy Quality Assurance (CDQA) Program was created to assist dairy producers with navigating and complying with the rules and regulations governing the industry. The CDQA program is a voluntary partnership between dairy producers, government agencies, and academia to address environmental stewardship, animal welfare, and food safety issues. The environmental stewardship module has three components: education, self-assessment, and third-party evaluation, terminating in certification, and focuses on compliance with federal, state, and local water quality regulations. A comprehensive checklist is used as the assessment tool in the certification process (<http://www.cdqa.org/>).
- The Equine Facilities Assistance Program. In July of 1997, the Council of Bay Area Resource Conservation Districts launched the program entitled “Non-Point Source Water Pollution Reduction through Improved Animal Waste and Resource Management at Equestrian Facilities in the San Francisco Bay Area,” to promote sound conservation practices at horse facilities. A manual and fact sheets can be found at the project’s Web site (<http://www.baysavers.org/Programs/horse/horseintro.htm>).

#### 2.1.4.2 Management Practices

The purpose of this management measure is to limit the discharge of manure, litter, and process wastewater from a confined animal facility that is not a Concentrated Animal Feeding Operation (CAFO). Facilities that are defined as CAFOs under USEPA regulations (40 CFR §122.23) are considered point source dischargers and must secure coverage under an NPDES permit. Such facilities are subject to the terms and conditions of that permit.

All other confined animal facilities are considered nonpoint sources. These nonpoint sources, however, must still comply with animal waste discharge standards found at sections 22560 through 22565 of Title 27 of the California Code of Regulations (<http://www.calregs.com>) and with any applicable WDRs or waiver. The following practices are recommended for controlling and preventing NPS pollution from confined animal facilities. These practices may also be helpful in achieving compliance with statewide requirements:

- Liquid manure storage structures should be designed to store facility wastewater and the contaminated runoff from confined animal facilities at all times, up to and including storms exceeding a 25-year, 24-hour frequency event, and should be consistent with nutrient management plans designed for the facility.
- Dry manure should be stored in production buildings or storage facilities, or otherwise covered to prevent manure from coming into contact with rainwater and entering surface waters through runoff.
- Each facility should have a nutrient management plan ([USDA NRCS Standard 590](#)) and land-apply manure and process wastewater in accordance with the plan.
- Clean water should be diverted from contact with feedlots and holding pens, animals, and manure storage facilities through the use of berms, diversions, roofs, or enclosures.
- Dead animals should be managed in a way that does not affect water quality.
- Seepage of liquid wastes to ground and surface water should be prevented through the use of impermeable linings for liquid storage ponds and concrete pads for solid storage and animal traffic areas.

#### 2.1.4.3 Information Resources

- **University of California, Davis, Animal Science Extension, *Dairy Manure Management Series*** (<http://animalscience.ucdavis.edu/extension/WasteManagement.htm>): This Web site series provides information on dairy waste management.
- **Orange County, CA, *Water Quality Guidelines for Horse and Livestock Activities*** (<http://www.ocwatersheds.com/brochures/horses.pdf>): This brochure has been prepared to inform residents in Orange County of the guidelines recommended for horse and livestock management to protect the water quality in storm drains, channels, creeks, bays, and the ocean.
- **USEPA Region 9, Animal Waste Management** ([http://www.epa.gov/region09/cross\\_pr/animalwaste/index.html](http://www.epa.gov/region09/cross_pr/animalwaste/index.html)): This Web site provides information on waste management programs for animal feeding operations in USEPA Region 9.
- **USEPA, National Agriculture Compliance Assistance Center** (<http://www.epa.gov/agriculture/anafobmp.html>): This Web site provides information on operating procedures, schedules of activities, maintenance procedures, and other management practices that confined animal facilities can use to prevent or reduce pollution.
- **USDA NRCS, Nation Water and Climate Center, Animal Waste Management** (<http://www.wcc.nrcs.usda.gov/awm/>): This Web site contains links to tools and information related to the development of animal waste management systems and comprehensive nutrient management plans (CNMPs) for confined animal facilities.
- **USDA NRCS, Animal Feeding Operations** (<http://www.nrcs.usda.gov/programs/afo/>). This Web site has information on comprehensive nutrient management planning for animal feeding operations.
- **USDA NRCS, *Agricultural Waste Management Field Handbook*** (<http://www.wcc.nrcs.usda.gov/awm/awmfh.html>). This handbook provides technical assistance for facilities designing agricultural waste management systems.

- **Council of Bay Area Resource Conservation Districts, *Horse Keeping: A Guide to Land Management for Clean Water*** (<http://www.baysavers.org/Programs/horse/fact.htm>): This Web site has a series of informational materials on environmentally sound horse-keeping practices.
- **Livestock and Poultry Curriculum, *Module C Manure Storage and Treatment and Module D Land Application and Nutrient Management*** ([http://www.lpes.org/les\\_plans.html](http://www.lpes.org/les_plans.html)): The Livestock and Poultry Curriculum is a national curriculum and supporting educational tools developed for U.S. livestock and poultry industry advisors and producers to help them acquire certification and achieve environmentally sustainable production systems. Modules C and D provide presentations and material on manure storage, storage technology, treatment technologies, manure utilization plans, land application management practices, record keeping, and sampling.
- **University of Illinois, College of Agriculture, Cooperative Extension Service, *60 Ways Farmers Can Protect Their Surface Water*** (<http://www.thisland.uiuc.edu/60ways/60ways.html>): This Web site provides information on managing livestock waste effectively.

#### 2.1.4.4 Case Study

*The Dairy Biologically Integrated Farming Systems (BIFS) Project: Integrating Forage Production with Dairy Manure Management in the San Joaquin Valley.* In California's Central Valley, dairy manure has been identified as a source of nitrate that contributes to ground water pollution. The Dairy BIFS project encourages dairy farmers to manage manure as a valuable source of nutrients for forage crops used in the same dairy. This reduces environmental pollution while decreasing dairy production costs. Participating farmers have been able to drastically reduce, and in some cases, completely forgo, the application of synthetic nitrogen to their crops without affecting yield. Recent results indicate a substantial reduction in nitrogen, potassium, and phosphorus inputs without reductions in yield (<http://dairybifs.uckac.edu/>).

#### 2.1.4.5 References

- USDA. No date. *Electronic Field Office Technical Guide for California*. U.S. Department of Agriculture, Natural Resource Conservation Service. (<http://efotg.nrcs.usda.gov/>)
- USEPA. 2002. Chapter 4: Management Measures. In *National Management Measures for the Control of Nonpoint Pollution from Agriculture*. U.S. Environmental Protection Agency, Washington DC. (<http://www.epa.gov/owow/nps/agmm/>)

**Fact Sheet Links:**

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## 2.1.5 Management Measure 1C Nutrient Management

### *Management Measure*

Develop, implement, and periodically update a nutrient management plan to (1) apply nutrients at rates necessary to achieve realistic crop yields, (2) improve the timing of nutrient application, and (3) use agronomic crop production technology to increase nutrient use efficiency. When the source of the nutrients is other than commercial fertilizer, determine the nutrient value and the rate of availability of the nutrients. Determine and credit the nitrogen contribution of any legume crop. Soil and plant tissue testing should be used routinely. Nutrient management plans contain the following core components:

1. Farm and field maps showing acreage, crops, soils, and water bodies.
2. Realistic yield expectations for the crop(s) to be grown, based primarily on the producer's yield history, State Land Grant University yield expectations for the soil series, or USDA NRCS Soils-5 information for the soil series.
3. A summary of the nutrient resources available to the producer, which at a minimum include (a) soil test results for pH, phosphorus, nitrogen, and potassium; (b) nutrient analysis of manure, sludge, mortality compost (birds, pigs, etc.), or effluent (if applicable); (c) nitrogen contribution to the soil from legumes grown in rotation (if applicable); and (d) other significant nutrient sources (e.g., irrigation water).
4. An evaluation of the field limitations based on environmental hazards or concerns such as (a) sinkholes, shallow soils over fractured bedrock, and soils with high leaching potential; (b) lands near surface water; (c) highly erodible soils; and (d) shallow aquifers.
5. Use of the limiting nutrient concept to establish a mix of nutrient sources and requirements for the crop based on realistic yield expectations.
6. Identification of timing and application methods for nutrients to: (a) provide nutrients at rates necessary to achieve realistic yields, (b) reduce losses to the environment, and (c) avoid applications as much as possible to frozen soil and during periods of leaching or runoff.
7. Provisions for the proper calibration and operation of nutrient application equipment.
8. Steps to ensure that when manure from confined animal facilities (excluding CAFOs) is to be used as a soil amendment or is disposed of on land, subsequent irrigation of the land does not leach excess nutrient to surface or ground waters.

### 2.1.5.1 Programs

- Pacific Northwest Collaborative Nutrient Management Education Program works to increase the ability of agricultural professionals to support landowners in sustainable nutrient management decisions that minimize negative impacts of nutrients on the environment and human health (<http://wsare.usu.edu/pro/pr2002/EW00-011.pdf>).

- University of California, Davis, Department of Animal Sciences offers assistance with planning and designing dairy waste management facilities and estimating the nutrient application rate of dairy manure (<http://animalscience.ucdavis.edu/java/DairyWasteMgt/default.htm>).

### 2.1.5.2 Management Practices

The purpose of this management measure is to reduce the nutrient loss from agricultural lands, which occurs through edge-of-field runoff or leaching from the root zone. The most effective way to manage nutrients is to develop a nutrient management plan (NMP) in accordance with USDA NRCS Standard 590. NMPs should be updated at least once every 5 years or once per crop rotation period. Records of nutrient use and sources should be maintained for easy reference. Components of an NMP include the following:

- Farm and field maps showing acreage, crops, soils, and water bodies.
- Realistic yield expectations for the crop(s) to be grown based primarily on the producer's yield history, State Land Grant University yield expectations for the soil series, or USDA NRCS Soils-5 information for the soil series.
- A summary of the nutrient resources available to the producer, which at a minimum include (a) soil test results for pH, phosphorus, nitrogen, and potassium; (b) nutrient analysis of manure, sludge, mortality compost (birds, pigs, etc.), or effluent (if applicable); (c) nitrogen contribution to the soil from legumes grown in rotation (if applicable); and (d) other significant nutrient sources (e.g., irrigation water).
- An evaluation of the field limitations based on environmental hazards or concerns such as (a) sinkholes, shallow soils over fractured bedrock, and soils with high leaching potential; (b) lands near surface water; (c) highly erodible soils; and (d) shallow aquifers.
- Use of the limiting nutrient concept to establish a mix of nutrient sources and requirements for the crop based on realistic yield expectations.
- Identification of timing and application methods for nutrients to (a) provide nutrients at rates necessary to achieve realistic yields, (b) reduce losses to the environment, and (c) avoid applications as much as possible to frozen soil and during periods of leaching or runoff.
- Provisions for the proper calibration and operation of nutrient application equipment.
- Provisions to ensure that, when manure from confined animal facilities (excluding CAFOs) is to be used as a soil amendment or is disposed of on land, subsequent irrigation of the land does not leach excess nutrient to surface or ground waters.

### 2.1.5.3 Information Resources

- **California Department of Food and Agriculture's Fertilizer Research and Education Program (FREP)** (<http://www.cdffa.ca.gov/is/frep/index.htm>): This program was created to advance the environmentally safe and agronomically sound use and handling of fertilizer materials. FREP facilitates and coordinates research and demonstration projects by providing funding and developing and disseminating information. It funds research to develop information on crops, irrigation methods, and nitrate in the soil as well as other environmental issues related to fertilizer use, such as heavy metals.
- **University of California, Davis, Pomology Department, Nitrogen Fertilization Recommendation for Almond** ([http://fruitsandnuts.ucdavis.edu/almondNKmodel/almond\\_n\\_model.htm](http://fruitsandnuts.ucdavis.edu/almondNKmodel/almond_n_model.htm)): This model calculates



the nitrogen requirement for almond production based upon the yield history, current conditions, and previous nitrogen applications. This model can be used to calculate both timing and rate of fertilizer application required to maintain optimum yield. Site-specific information is required for accurate projection of nitrogen requirement; hence this model should be applied to each distinct management unit, such as a block or field. The data used in this model were derived from exhaustive tree-nitrogen budget determinations.

- **CORE4, Crop Nutrient Management** (<http://www.ctic.purdue.edu/Core4/nutrient/nutrmgmt.html>): This Web site provides information, links, and resources on crop nutrient management planning.
- **California Certified Crop Advisors** (<http://www.cacca.org/>): The California Certified Crop Advisors (CCA) can help producers grow economically and environmentally sound crops. The California CCA program is a voluntary certification program for individuals who provide advice to growers on crop management and inputs. Their Web site lists certified crop advisors for California. For more information contact the California CCA (Telephone: 916-928-1625).
- **USDA Draft Comprehensive Nutrient Management Planning Technical Guidance** ([http://www.nrcs.usda.gov/programs/afo/cnmp\\_guide\\_index.html](http://www.nrcs.usda.gov/programs/afo/cnmp_guide_index.html)): USDA NRCS guide on comprehensive nutrient management planning.
- **Colorado Comprehensive Nutrient Management Plan Workbook** (<http://www.colostate.edu/Depts/SoilCrop/extension/Soils/cnmp/>): This Web site is designed to take livestock producers through the process of developing a comprehensive nutrient management plan, step-by-step. Livestock producers of all kinds including cattle-feeders, dairies, cow-calf operations, horse owners, and poultry and pork producers can use the Comprehensive Nutrient Management Plan Workbook.
- **Livestock and Poultry Curriculum, Module A Introduction and Module D Land Application and Nutrient Management** ([http://www.lpes.org/les\\_plans.html](http://www.lpes.org/les_plans.html)): The Livestock and Poultry Curriculum is a national curriculum and supporting educational tools developed for U.S. livestock and poultry industry advisors and producers to help them acquire certification and achieve environmentally sustainable production systems. Modules A and D provide presentations and material on whole farm nutrient planning, manure utilization plans, land application management practices, phosphorus management, record keeping, and sampling.
- **National Agriculture Compliance Center, Crops** (<http://www.epa.gov/agriculture/crops.html>): This page provides information about environmental requirements specifically relating to the production of many types of agricultural crops, including food, feed, and fiber crops, and specialty crops, such as tobacco, herbs, spices, mushrooms, seed crops, and aquatic plants.
- **University of Illinois, College of Agriculture, Cooperative Extension Service, 60 Ways Farmers Can Protect Their Surface Water** (<http://www.thisland.uiuc.edu/60ways/60ways.html>): This Web site includes information on managing nutrients effectively.
- **California Dairy Quality Assurance (CDQA) Program** (<http://www.cdqa.org>): This project assists dairy producers to comply with the regulations governing confined animal facilities by providing educational resources and funding in the areas of food safety, animal health and welfare, and environmental stewardship.
- **North Carolina Agricultural Research Service, Selected Agricultural Best Management Practices to Control Nitrogen in the Neuse River Basin** (<http://www.soil.ncsu.edu/publications/BMPs/>): This bulletin summarizes best professional guidance on the selection and placement of management practices that will reduce nitrogen

loading from agriculture to selected river basins in North Carolina and discusses the efficacy of developing site-specific management practices.

- **CNMP Watch** (<http://www.cnmpwatch.com>): CNMP Watch is intended to provide guidance to agricultural producers in developing and writing CNMPs. The site provides visitors with national and state-specific information to complete the manure management, land application, and nutrient management planning required for animal feeding operations. The site includes news, events, case studies, tools, technologies, guidelines and regulations, and links to other pertinent information.

#### 2.1.5.4 Case Study

*University of California Helps Nurseries in Southern California Stop Polluting Waterways.* University of California scientists have found a way for nurseries in Southern California to reduce sediment, nutrient, and pesticide pollution associated with irrigation water runoff. In a case study of a large nursery in Orange County, researchers sought a low cost option to mitigate pesticide residues from a nursery treating plants for red fire ants. Scientists examined ways to reduce pesticide use but also sought a method to minimize irrigation water runoff. Researchers implemented two management practices to reduce this pollution: first, they built sediment traps and ponds to slow water and allow the sediment to settle; second, they planted canna lilies in a wide ditch to create a dense biological filter for sediment and nutrients. Two years of monitoring has shown a significant decrease in pollutant loading in an adjacent stream. Water samples taken downstream of the nursery showed reductions in nitrogen and phosphorus loads of 58 percent and 54 percent, respectively. Suspended solids were reduced 97 to 99 percent, and pesticides used to control red imported fire ant were consistently reduced by more than 90 percent. Researchers believe that this strategy can be used by other nurseries to reduce pollution associated with runoff (<http://news.ucanr.org/storyshow.cfm?story=618&printver=yes>).

#### 2.1.5.5 References

- USDA. No date. *Electronic Field Office Technical Guide for California*. U.S. Department of Agriculture, Natural Resource Conservation Service. (<http://efotg.nrcs.usda.gov/>)
- USEPA. 2002. Chapter 4: Management Measures. In *National Management Measures for the Control of Nonpoint Pollution from Agriculture*. U.S. Environmental Protection Agency, Washington, DC. (<http://www.epa.gov/owow/nps/agmm/>)

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## 2.1.6 Management Measure 1D Pesticide Management

### *Management Measure*

To reduce contamination of surface water and ground water from pesticides.

1. Evaluate the pest problems, previous pest control measures, and cropping history.
2. Evaluate the soil and physical characteristics of the site including mixing, loading, and storage areas for potential leaching or runoff of pesticides. If leaching or runoff is found to occur, steps should be taken to prevent further contamination.
3. Use integrated pest management (IPM) strategies that (a) apply pesticides only when an economic benefit to the producer will be achieved (i.e., applications based on economic thresholds), and (b) apply pesticides efficiently and at a time when runoff losses are unlikely.
4. When pesticides applications are necessary and a choice of registered materials exists, consider the persistence, toxicity, runoff potential, and leaching potential of products.
5. Periodically calibrate pesticide spray equipment.
6. Use anti-backflow devices on hoses used for filling tank mixtures.

### 2.1.6.1 Programs

- The California *Pesticide Management Plan for Water Quality* is a joint effort by the Department of Pesticide Regulation (DPR) and the SWRCB to protect water quality from the potential adverse effects of pesticides. It describes how DPR and the County Agricultural Commissioners work in cooperation with the SWRCB and the Regional Water Quality Control Boards (RWQCBs) to protect water quality from the use of pesticides (<http://www.cdpr.ca.gov/docs/dprdocs/waterpln/maaplan.htm>).
- The Department of Pesticide Regulation's Surface Water Quality Program addresses both agricultural and nonagricultural sources of pesticide residues in surface waters. It has preventive and response components that reduce the presence of pesticides in surface waters. The preventive component includes local outreach to promote management practices that reduce pesticide runoff. Prevention also relies on DPR's registration process in which potential adverse effects on surface water quality, particularly those in high-risk situations, are evaluated. The response component includes mitigation options to meet water quality goals, recognizing the value of self-regulating efforts to reduce pesticides in surface water as well as the regulatory authorities of DPR, the SWRCB, and the RWQCBs (<http://www.cdpr.ca.gov/docs/sw/>).
- The Department of Pesticide Regulation's Ground Water Quality Program addresses both agricultural and nonagricultural sources of pesticide residues in ground waters. The DPR is proposing to revise the Ground Water Quality Program by changing the current ground water regulations. For more information go to <http://www.cdpr.ca.gov/docs/gwp/>.

- The Coalition for Urban/Rural Environmental Stewardship (CURES) has two programs to promote the environmental friendly use of pesticides. The Water Steward Orchard Program is designed to promote awareness of pesticide runoff from products used in dormant orchard sprays. The Water Steward Rice Program is a rice pesticide stewardship plan launched by CURES, the California Rice Commission, and a broad coalition of grower and industry interests. The purpose of this program is to raise awareness of rice pesticides and impacts on the drinking water quality of the Sacramento River (<http://www.curesworks.org/>).
- California Department of Pesticide Regulation, Pest Management Alliance (<http://www.cdpr.ca.gov/docs/ipminov/ipmmenu.htm>): This program provides support for agricultural, nonagricultural, and urban groups to develop and demonstrate pest management systems that reduce risks associated with pesticide use, including risks to surface and ground waters. The Web site has Alliance project evaluations, reports, and other technical information available for pest management systems in various commodities such as almonds, stone fruit, and strawberries.

### 2.1.6.2 Management Practices

The purpose of this management measure is to reduce or eliminate pesticide runoff into surface water. The most effective approach is to apply pesticides as prescribed on the label with respect to timing and rate of chemical application. The following practices should be considered to reduce the likelihood that pesticides will pollute surface and ground water.

- *Evaluate pest control needs*: Determine the extent of the pest problems, previous pest control measures, and cropping history. Consider using integrated pest management (IPM) to reduce the amount of chemicals needed to manage pest damage. See the University of California Statewide Integrated Pest Management Program (<http://www.ipm.ucdavis.edu/>). Pest management practices should be updated when crop rotation, pest problems, or type of pesticide used have changed.
- *Reduce the risk of accidental spills*: Know the physical and soil characteristics of the area and evaluate the site for runoff potential to surface water and leaching potential to ground water. Note the location and proximity of the mixing, loading, and storage areas relative to surface water. Use anti-backflow devices on hoses used for filling tank mixtures and on chemigation systems.
- *Maintain application equipment*: Calibrate application equipment once a season and inspect application equipment for wear and damage.
- *Follow the label*: Apply and use pesticides as prescribed on the label and at times when leaching and runoff are least likely (not just before a rainstorm).
- *Protect surface waters from spills and contaminated runoff*: Install perimeter controls such as vegetative buffers to help prevent pesticide runoff into streams.

### 2.1.6.3 Information Resources

- **University of California Statewide Integrated Pest Management Program** (<http://www.ipm.ucdavis.edu/>): The UC IPM Program Web site contains information for practitioners on how to identify and manage pests, including educational resources, databases, publications, projects, and other resources.
- **University of California Statewide Integrated Pest Management Program, Dormant Spray Alternatives Calculator** (<http://www.ipm.ucdavis.edu/WATER/OPCALC/>): This calculator estimates the costs of using organophosphate dormant sprays and selected alternative practices. When compared to conventional organophosphate dormant sprays, the alternatives listed in the

calculator offer favorable levels of pest control efficacy with comparable ranges of cost, while affording a reduced risk of aquatic toxicity.

- **The National Integrated Pest Management Network (NIPMN)** (<http://www.ipmcenters.org/>): NIPMN is the result of a public-private partnership dedicated to making the latest and most accurate pest management information available on the World Wide Web. For projects and IPM techniques specific to the Western Region visit <http://www.wrpmc.ucdavis.edu/>.
- **University of California Cooperative Extension Service, Pests of Agricultural Crops, Floriculture and Ornamental Nurseries, and Commercial Turfgrass, *University of California Pest Management Guidelines*** (<http://www.ipm.ucdavis.edu/PMG/crops-agriculture.html>): This handbook includes guidelines for pest management in California.
- **The Coalition for Urban/Rural Environmental Stewardship** (<http://www.curesworks.org/>): The Coalition for Urban/Rural Environmental Stewardship (CURES) was founded in 1997 to support educational efforts for agricultural and urban communities focusing on the proper and judicious use of pest control products.
- **CORE4, *Weed and Pest Management*** (<http://www.ctic.purdue.edu/Core4/ipm/IPM.html>): This Web site provides information and resources related to weed and pest management.
- **University of Illinois, College of Agriculture, Cooperative Extension Service, *50 Ways Farms Can Protect Their Groundwater*** (<http://www.thisland.uiuc.edu/50ways/50ways.html>): This Web site provides information on how to reduce contamination of ground water from fertilizers, herbicides, and insecticides; how to use integrated pest management; and how to improve chemical application.
- **University of Illinois, College of Agriculture, Cooperative Extension Service, *60 Ways Farmers Can Protect Their Surface Water*** (<http://www.thisland.uiuc.edu/60ways/60ways.html>): This Web site includes information on reducing insecticide and pesticide use, selecting appropriate pesticides, and handling pesticides safely and efficiently.
- **Florida Department of Agriculture and Consumer Services and Florida Department of Environmental Protection, *Best Management Practices for Agrichemical Handling and Farm Equipment Maintenance*** (<http://www.dep.state.fl.us/water/nonpoint/docs/nonpoint/agbmp3p.pdf>).
- **California Department of Pesticide Regulation Fate Reviews** (<http://www.cdpr.ca.gov/docs/emprm/pubs/envfate.htm>): The Department of Pesticide Regulation publishes environmental fate reviews for many pesticides that are used in agriculture, including diuron, methoprene, and pyrethrins.
- **Yolo County Resource Conservation District. *Bring Farm Edges Back to Life*** ([http://www.yolored.org/education/Farm Edges v5 excerpt 2.pdf](http://www.yolored.org/education/Farm%20Edges%20v5%20excerpt%20.pdf)). This conservation guidebook provides information on managing unused farm areas to reduce erosion, enhance conservation, and manage pests and weeds.
- **Community Alliance with Family Farmers, *Hedgerows for California Agriculture: A Resource Guide*** (<http://www.caff.org/programs/farmscaping/Hedgerow.pdf>). This resource guidebooks includes information about using hedgerows and related practices as tools to increase groundcover and reduce soil erosion and to improve pesticide management. This guide includes information on the benefits of hedgerows, practical information about installing hedgerows, and other relevant reference materials.



#### 2.1.6.4 Case Studies

*Central Coast Vineyard Team Exploring Reduced Pesticide Use.* The Central Coast Vineyard Team (CCVT) is a community-based partnership of wine grape growers, wineries, University of California Cooperative Extension farm advisors, consultants, and the Department of Pesticide Regulation (DPR). Robert Mondavi Winery provided the leadership to create the team in 1995 to investigate ways to reduce pesticide use in the tri-county area. In 1996 the team received a grant from DPR to create California's first Positive Points System (PPS) for wine grapes. The PPS is being used to measure growers' environmental enhancement by evaluating their integrated farm management plans (<http://vineyardteam.org/>).

*Almond Pest Management Alliance.* The Almond Pest Management Alliance—with partners such as the Almond Hullers and Processors Association, the Community Alliance with Family Farmers, the University of California Statewide Integrated Pest Management Project, and University of California Cooperative Extension—is evaluating the possibility of reducing pesticide inputs in California almonds. Research began in 1998 when the California Department of Pesticide Regulation awarded its first grant to the Almond Pest Management Alliance. This effort was initiated because of two major concerns: The implementation of the federal Food Quality Protection Act, with the possible loss of some traditional crop protection tools, and growing public concern over water quality standards in the San Joaquin River and Sacramento River watersheds, with possible links to pesticides used by almond growers.

The evaluation consists of three regional projects to encompass the variability of the almond-growing area of California. Each project compares conventional treatment areas with reduced risk treatment areas using practices appropriate for local conditions. The fourth year of the Almond Pest Management Alliance has also demonstrated that (a) extensive orchard monitoring is the key to the success of this approach, (b) reduced risk practices appear to be controlling the pests below economic damage levels, (c) other pests may begin to build populations after spray programs are altered, and (d) growers are interested in reduced risk practices and continue to be proactive. As the Almond Pest Management Alliance entered its fifth year in mid-2002, its goals included involving more pest control advisors (PCAs) and growers in monitoring during the crop season and through the dormant season; implementing smaller, more frequent, more regionally based field meetings regarding reduced risk practices; creating guidelines or protocols for reduced risk pest management in almonds based on what has been learned in the Pest Management Alliance project, and using a continuing Pest Management Alliance as an umbrella sponsorship entity to continue IPM and related agricultural stewardship research (<http://www.cdpr.ca.gov/docs/empm/alliance/00-01/00-0210S.pdf>).

*Lodi-Woodbridge Winegrape Commission (LWWC) Sustainable Viticulture Program.* There are three parts to LWWC's Sustainable Viticulture Program: grower outreach, field implementation, and area-wide implementation. Grower outreach involves providing information to LWWC growers and PCAs about sustainable farming practices that are appropriate for use in their vineyards. This information is provided in a range of different ways briefly discussed below. The field implementation component involves working with a core group of 40 LWWC growers and about 15 PCAs in 60 different vineyards. Various sustainable farming practices are implemented in these vineyards so the growers and other LWWC members can see the effects of these practices. Area-wide implementation involves encouraging all LWWC members to become more active in implementing sustainable viticultural practices in their vineyards. The *Lodi Winegrower's Workbook* (<http://www.lodiwine.com/winegrowersworkbook1.shtml>) was written to help achieve area-wide implementation. More information about the Sustainable Viticulture Program can be found at <http://www.lodiwine.com/viticultureprogram1.shtml>.

*Bioassessment Pilot Study to Identify Impacts on the Benthic Macroinvertebrate Community Due to Surface Runoff of Pesticides.* This study, conducted by the Department of Pesticide Regulation (DPR) in Sacramento, California, will use chemical analysis to determine the presence of pesticides in surface

waters. This bioassessment will serve as a supplementary tool to help assess the ecological impacts of pesticides. The final report is expected June 30, 2006

(<http://www.cdpr.ca.gov/docs/empm/pubs/protocol/225protocol1.pdf>).

*Continuing Assessment of Pyrethroid Contamination of Surface Waters and Bed Sediments in High Pyrethroid-Use Regions of California.* This study aims to characterize the extent of pyrethroid insecticide contamination of surface waters in four high-use regions of California as correlated with high organophosphate use. The final report is expected in April 2007.

(<http://www.cdpr.ca.gov/docs/empm/pubs/protocol/study229protocol.pdf>).

#### 2.1.6.5 References

USDA. No date. *Electronic Field Office Technical Guide for California*. U.S. Department of Agriculture, Natural Resource Conservation Service. (<http://efotg.nrcs.usda.gov/>)

USEPA. 2002. Chapter 4: Management Measures. In *National Management Measures for the Control of Nonpoint Pollution from Agriculture*. U.S. Environmental Protection Agency, Washington, DC. (<http://www.epa.gov/owow/nps/agmm/>)

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## 2.1.7 Management Measure 1E Grazing Management

### *Management Measure*

Protect range, pasture, and other grazing lands by

1. Implementing one or more of the following to protect sensitive areas (such as streambanks, wetlands, estuaries, ponds, lake shores, and riparian zones): (a) exclude livestock, (b) provide stream crossings or hardened access to watering areas, (c) provide alternative drinking water locations away from surface waters, (d) locate salt and additional shade, if needed, away from sensitive areas, or (e) use improved grazing management (e.g., herding) to reduce the physical disturbance and reduce direct loading of animal waste and sediment caused by livestock; and
2. Achieving either of the following on all range, pasture, and other grazing lands not addressed under (1) above: (a) implement the range and pasture components of a CMS as defined in the USDA NRCS *Field Office Technical Guide* by applying the progressive planning approach of the USDA NRCS to reduce erosion, or (b) maintain range, pasture, and other grazing lands in accordance with activity plans established by the Bureau of Land Management of the U.S. Department of the Interior or the USDA Forest Service or the California Rangeland Water Quality Management Plan.

### 2.1.7.1 Programs

- The California Board of Forestry's California Rangeland Water Quality Management Plan is a voluntary plan developed by the California Cattlemen's Association, in collaboration with University of California Cooperative Extension and USDA NRCS. The plan was officially approved in 1995 and includes rangeland water quality management strategies, policy and coordination mechanisms, as well as sample plans and sources of assistance. The California Board of Forestry is responsible for administering the plan (<http://www.calcattlemen.org/1%20Industry%20Issues/1%20Producer%20Information/CA%20Rangeland%20Water%20Quality%20Mgmt%20Plan.pdf>).
- The Bureau of Land Management (BLM) has begun implementing the standards for rangeland health and guidelines for livestock grazing that apply to public lands administered by BLM in central and northern California and northwestern Nevada ([http://www.ca.blm.gov/caso/sg\\_8-99.html](http://www.ca.blm.gov/caso/sg_8-99.html)).
- The California Cattlemen's Association's Rangeland and Water Quality Web site provides access to the California Rangeland Water Quality Management Plan, which addresses both governmental policy and management strategies. The Grazing for Change booklet features nine California rancher's range and watershed management success stories. The ongoing Riparian Grazing Project serves as another useful tool for range managers (<http://californiarangeland.ucdavis.edu/STATE%20WATER%20RESOURCES%20CONTROL%20BOARD.htm>).
- The California Grazing Academy is a unique and exciting program emphasizing practical application of controlled grazing principles to improve the environment and increase ranch profit. This challenging course consists of a minimum of lecture and a maximum of hands-on experience

and learning ([http://ceplacer.ucdavis.edu/Livestock/California\\_Grazing\\_Academy\\_-\\_Low-Stress\\_Livestock\\_Handling\\_School.htm](http://ceplacer.ucdavis.edu/Livestock/California_Grazing_Academy_-_Low-Stress_Livestock_Handling_School.htm)).

- The California Department of Pesticide Regulation, Pest Management Alliance. DPR's Pest Management Alliance program provides funding support, when funds become available, to encourage increased implementation of biologically intensive, reduced-risk pest management. This program is designed to create a collaborative, interdisciplinary team that uses a systems approach—the assumption is that team members have already solved pest problems and other specialized components through applied research. The Alliance is part of a problem-solving continuum, taking the data collected from research and preparing for the next stage—education through demonstration, and ultimately implementation. An overview of the program is available at <http://www.cdpr.ca.gov/docs/empm/alliance/overview.htm>; project summaries since 1998 are available at <http://www.cdpr.ca.gov/docs/empm/alliance/allisums.htm>.

### 2.1.7.2 Management Practices

The purpose of this management measure is to protect sensitive areas in range, pasture, and other grazing lands. California-approved USDA NRCS standards required for a conservation management systems should be applied to the entire grazing area. These components include erosion control, adequate pasture stand density, and rangeland condition. Recommended practices include the following:

- Carefully plan the use of grazing areas by developing a grazing management plan with the goal of improving or maintaining water quality. Use prescribed grazing techniques to harvest vegetation in a controlled manner by managing the intensity, frequency, and duration of grazing.
- Prevent erosion from wind or water by maintaining sufficient vegetative cover to stabilize soils. Where feasible, consider installing windrows or wind fences to reduce wind velocity and erosion.
- Keep animals out of surface waters: exclude animals, people, or vehicles to protect and maintain plant and water quality and prevent or minimize direct loading of animal waste and sediment into surface waters. Install alternative drinking sources (e.g., pipelines, ponds, troughs, tanks, and wells) to keep animals away from sensitive waters and install hardened access points so animals have access to drinking water sources. Use fences, hedgerows, moats, and other practices to keep animals away from sensitive areas and place mineral supplements and additional shade away from sensitive areas.
- Provide designated, stabilized stream crossings for livestock and equipment to minimize impacts on stream habitat and water quality.
- Use structural range improvements like access roads, grade stabilizers, sediment ponds, stalk trails or walkways, troughs and tanks, pipelines, and streambank protection to maintain vegetation and slopes and prevent waterway degradation.
- Use non-structural practices such as planting of native vegetation, especially along channels or in critical areas; prescribed burning; range seeding; brush management; stream corridor improvement; and wetland and upland wildlife management to manage vegetation, prevent erosion, and protect wildlife habitat.
- Allow for a vegetative buffer strip/filter strip to remain around sensitive areas (such as streambanks, ponds, lake shores, and riparian zones) to help facilitate infiltration and ultimately prevent polluted runoff from directly entering surface waters.

- Periodically monitor the conditions of grazing lands to ensure that management practices are effective, and if not, implement new practices or modify existing practices to maintain vegetation and protect soils and waterways.

### 2.1.7.3 Information Resources

- ***Grazing for Change, Range and Watershed Management Success Stories in California***. For information about ordering a copy of this booklet, contact the California Cattlemen's Association (Telephone: 916-444-0845; E-mail: [staff@calcattlemen.org](mailto:staff@calcattlemen.org)).
- **University of California, Davis, California Rangelands Research Information Center** (<http://californiarangeland.ucdavis.edu/>): The purpose of this Web site is to develop research and extension education initiatives and to foster collaboration between California rangeland researchers and educators.
- **University of California, Davis, Cooperative Extension, Controlled Grazing** (<http://www.foothill.net/~ringram/gzoption.htm>): This Web site provides information on controlled grazing, which is a flexible management method that balances plant and animal requirements.
- **USDA NRCS, Grazing Land Conservation Initiative** (<http://www.nrcs.usda.gov/programs/glci/>): The Grazing Land Conservation Initiative (GLCI) is a nationwide collaborative process of individuals and organizations working to maintain and improve the management, productivity, and health of the nation's privately owned grazing land. This process has formed coalitions that represent the grassroots concerns that impact private grazing land. The coalitions actively seek sources of funding to increase technical assistance and pursue public awareness activities that maintain or enhance grazing land resources.
- **Marin Coastal Watershed Enhancement Project, *Ranch Plan Workbook*** (<http://www.sarep.ucdavis.edu/NEWSLTR/v8n3/sa-4.htm>): The workbook includes a working copy of a ranch plan to assist with writing planned management practices, a fact sheet on management measures and practices by the Rangeland Watershed Program, and *Appropriate Animal Waste Guidelines*.
- **The USDA Forest Service's *Proposed Range Standards and Guidelines to Amend the Land and Resource Management Plans of the Tahoe and Eldorado National Forests*** (<http://www.epa.gov/fedrgstr/EPA-IMPACT/1997/August/Day-13/i21345.htm>):
- **Montana Department of Natural Resources and Conservation, *Best Management Practices for Grazing*** (<http://www.homepage.montana.edu/~harries/>): This Web site presents grazing management practices for a water quality demonstration project.
- **National Agriculture Compliance Center, *Pasture, Grazing, and Rangeland Operations*** (<http://www.epa.gov/agriculture/anprgidx.html>): This Web site provides information about environmental requirements specifically relating to livestock production in pastures and rangeland, as well as other grazing operations.
- **California Native Plant Society, *Conservation Topics*** (<http://www.cnps.org/programs/conservation/grazing.htm>): The California Native Plant Society (CNPS) is a statewide non-profit organization that focuses on livestock management techniques. CNPS develops reviews and digests of scientific literature on grazing management issues and develops detailed management proposals for both the Bureau of Land Management and the U.S. Forest Service. This Web site provides links to additional information on livestock grazing and recommended management strategies.



- **National Range and Pasture Handbook.** U.S. Department of Agriculture, Natural Resources Conservation Service, Grazing Lands Technology Institute (1997). (<http://www.glti.nrcs.usda.gov/technical/publications/nrph.html>): This manual covers inventorying, monitoring, and managing grazing lands as well as livestock nutrition, behavior, and husbandry. Special sections deal with the economics of grazing, wildlife management, and hydrology.
- **National Sustainable Agriculture Information Service, *Managed Grazing in Riparian Areas*** (<http://www.attra.org/attra-pub/managedgraze.html>): The National Sustainable Agriculture Information Service (ATTRA) provides information and technical assistance to farmers, ranchers, educators, and others involved in sustainable agriculture. *Managed Grazing in Riparian Areas* is designed to help farmers and ranchers identify and use locally appropriate grazing practices to protect riparian resources, including keeping livestock from streambanks, properly resting pastures to restore degraded land, and determining the proper duration and season for grazing pastures. Other relevant publications to which this Web site links include the following:
  - ***Protecting Riparian Areas: Farmland Management Strategies*** (<http://www.attra.org/attra-pub/riparian.html>),
  - ***Sustainable Pasture Management*** (<http://www.attra.org/attra-pub/sustpast.html>),
  - ***Rotational Grazing*** (<http://www.attra.org/attra-pub/rotategr.html>),
  - ***Nutrient Cycling in Pastures*** (<http://www.attra.org/attra-pub/nutrientcycling.html>),
  - ***Assessing the Pasture Soil Resource*** (<http://www.attra.org/attra-pub/pastsoil.html>),
  - ***Matching Livestock and Forage Resources in Controlled Grazing*** (<http://www.attra.org/attra-pub/matchlandf.html>), and
  - ***Grazing Networks for Livestock Producers*** (<http://www.attra.org/attra-pub/grazingnetworks.html>).
- **USEPA, National Management Measures to Control Nonpoint Source Pollution from Agriculture, Chapter 4E: Grazing Management.** (<http://www.epa.gov/owow/nps/agmm/index.html>): Chapter 4E covers grazing management topics including an overview of grazing issues, environmental impacts of grazing, grazing management practices, factors to be considered when selecting management practices, and costs/savings of practices. The document also refers readers to additional resources on grazing management.
- **Aqouridis, C.T., S.R. Workman, R.C. Warner, and G.D. Jennings (2005) *Livestock Grazing Management Impacts on Stream Water Quality: A Review*** (<http://www.rednova.com/modules/news/tools.php?tool=print&id=176661>): This review paper examines the peer-reviewed literature pertaining to grazing practices commonly implemented in the southern humid region of the United States to ascertain effects of management practices on stream water quality. Results indicate that the most extensive research efforts occurred in the western and midwestern U.S. Also, many studies documented the negative impacts of grazing on stream health, but few examined the success of management practices in mitigating these effects or provided information to enable the reader to determine the efficacy of a comprehensive

systems approach integrating multiple practices with pre- and post-implementation geomorphic conditions.

- **Burns, R.T., and M.J. Buschermohle (2002) *Selection of Alternative Livestock Watering Systems*** (<http://www.utextension.utk.edu/publications/pbfiles/PB1641.pdf>): This publication describes livestock watering system alternatives available to producers. These systems can be divided into three basic types: direct access, gravity flow and pressure systems. The best system type for a particular producer will depend on many factors, including site layout, water requirement, availability and cost of utility water and electricity, as well as water source type and location. This publication provides basic descriptions of some livestock watering system alternatives and discusses some of the positive and negative aspects of each.
- **Galt, D., F. Monlinar, J. Navarro, J. Joseph, and J. Holecheck (2000) *Grazing Capacity and Stocking Rate*** (<http://uvalde.tamu.edu/rangel/dec00/galt.pdf>): This study outlines the benefits of conducting grazing capacity studies and describes procedures for establishing grazing capacity and setting stocking rates.

#### 2.1.7.4 Case Studies

*The Sustainable Ranching Research and Education Project.* The project is a long-term effort to improve the economic, environmental, and social sustainability of ranching (<http://ceplacer.ucdavis.edu/livestock/publications/sustranchovervw.pdf>).

*The Morro Bay Watershed Project.* Morro Bay, one of the few intact natural estuaries along California's coast, is being impaired primarily by sediment. Brushland, rangeland, and streambank erosion contribute the largest portion of sediment deposited in the bay. The Morro Bay Watershed project is evaluating the effectiveness of sediment-reducing management practices, such as the creation of smaller pastures, installation of cattle watering systems, stabilization and revegetation of streambanks, and installation of water bars and culverts on farm roads. At one of the watershed study sites, a 49 percent reduction in turbidity was documented. A suite of management practices, including improved grazing management, riparian fencing, and revegetation, was responsible for the reduction in turbidity. These practices have also proved to be effective in reducing bacteria levels in adjacent streams in the watershed (<http://www.bae.ncsu.edu/programs/extension/wqg/section319/page1.htm>).

*An Assessment of the Quality of Agricultural Best Management Practices in the James River Basin of Virginia.* Cunningham (2003) undertook a study to assess the quality of agricultural management practices to determine if differences in quality existed between practices built using federal, state, or local cost-share funds, which are required to adhere to state standards, and practices implemented without cost-share funding, which are not required to adhere to standards. Many watershed plans and models only include cost-share-funded practices, presuming that they would be higher-quality than self-funded practices. Cunningham developed assessment tools to quantify the quality of 16 different types of agricultural management practices and compared 155 cost-share practices to 150 non-cost-share practices on 128 farms in the James River Basin of Virginia. Across all management practices, quality did not differ significantly between the cost-share and non-cost-share practices. Non-cost-share filter/buffer strips were significantly higher quality than cost-share filter/buffer strips, whereas cost-share stream fencing was significantly higher quality than non-cost share. Cunningham looked at the effects of the age of the practice, farm size, and soil and water conservation district (SWCD) on management practice quality and found that one SWCD (the Robert E. Lee district), had significantly higher quality management practices than the other SWCDs (<http://scholar.lib.vt.edu/theses/available/etd-09032003-141020/unrestricted/JanelleCThesisFinal.pdf>).

### 2.1.7.5 References

- Cunningham, J.H. 2003. *An Assessment of the Quality of Agricultural Best Management Practices in the James River Basin of Virginia*. Master's Thesis, Virginia Polytechnic Institute and State University, Blacksburg, VA.
- SWRCB. 1995. *California Rangeland Water Quality Management Plan*. State Water Resources Control Board, Division of Water Quality, NPS Program, Sacramento, CA.
- USDA. No date. *Electronic Field Office Technical Guide for California*. U.S. Department of Agriculture, Natural Resource Conservation Service. (<http://efotg.nrcs.usda.gov/>)
- USEPA. 2002. Chapter 4 Management Measures. In *National Management Measures for the Control of Nonpoint Pollution from Agriculture*. U.S. Environmental Protection Agency, Washington, DC. (<http://www.epa.gov/owow/nps/agmm/>)

**Fact Sheet Links:**

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## 2.1.8 Management Measure 1F Irrigation Water Management

### *Management Measure*

To reduce NPS pollution of surface and ground waters caused by irrigation.

1. Operate the irrigation system so that the timing and amount of irrigation water applied match crop water needs. This requires, as a minimum, (a) the accurate measurement of soil-water depletion volume and the volume of irrigation water applied, and (b) uniform application of water.
2. When chemigation is used, include backflow preventers for wells, minimize the harmful amounts of chemigation waters that discharge from the edge of the field, and control deep percolation. In cases where chemigation is performed with furrow irrigation systems, a tailwater management system may be needed.

### 2.1.8.1 Programs

- The California Department of Water Resources' California Irrigation Management Information System (CIMIS) helps agricultural growers and turf managers who administer parks, golf courses, and other landscapes to develop water budgets for determining when to irrigate and how much water to apply (<http://www.cimis.water.ca.gov/>).
- The Department of Water Resources' Agriculture Water Management Planning Program provides technical, financial, and administrative assistance to the Agricultural Water Management Council and to the water districts throughout the State to develop water management plans and to help implement cost-effective, efficient water management practices (<http://www.owue.water.ca.gov/agmanage/index.cfm>).
- AgLine Online, the Kings River Conservation District's AgLine information system, provides crop water use information for the Kings River service area. Information provided for each crop includes crop water use for the past 7 days, predicted water use for the next 7 days, and total crop water use for the season to date. The numbers are updated every Friday and can be used to assist growers in irrigation management decisions. AgLine includes crop water use data for 31 cropping cases (<http://krcd.org/>).
- Westland Water District's Water Conservation Cost-Share Programs continues to offer the Expanded Irrigation System Improvement Program (EISIP) to district water users and landowners. This program offers low interest rates to water users for the lease-purchase of irrigation system equipment funded by State Revolving Fund loans. The EISIP offers the opportunity to lease portable aluminum irrigation equipment and other improved irrigation systems, including microirrigation, linear move and center pivots, and tailwater reuse systems. The Agricultural Pumping Efficiency Program is available for all agricultural electric and natural gas utility accounts that are used for pumping water and paying the Public Goods Charge (customers of Pacific Gas and Electric Company, Southern California Edison Company, Southern California Gas Company, or San Diego Gas and Electric Company) (<http://www.westlandswater.org/wtrcon/costshare.htm>).
- **Central Valley RWQCB, Conditional Waiver Program for Irrigated Agriculture** ([http://www.waterboards.ca.gov/centralvalley/programs/irrigated\\_lands/](http://www.waterboards.ca.gov/centralvalley/programs/irrigated_lands/)): The Central Valley

Regional Board adopted the Conditional Waiver Program for irrigated lands in July 2003. Under the Conditional Waiver Program, growers with irrigated lands that discharge waste that can degrade surface water quality must now select one of three options to obtain regulatory coverage under the Water Code. Those affected include growers (owners/operators) of irrigated lands; managers of wetlands; and local districts who discharge tailwater, water from underground drains, water from operational spills, and storm water runoff to surface waters.

- **Central Coast RWQCB, Conditional Waiver Program for Irrigated Agriculture** (<http://www.waterboards.ca.gov/centralcoast/AGWaivers/Index.htm>). The Central Coast Regional Board adopted Conditional Waiver of Waste Discharge Requirements for Discharges From Irrigated Lands in July 2004. The intent of this Conditional Waiver is to regulate discharges from irrigated lands to ensure that such discharges are not causing or contributing to exceedances of any Regional, State, or Federal numeric or narrative water quality standard. Irrigated lands are lands where water is applied for producing commercial crops and, for the purpose of this program, include, but are not limited to, land planted to row, vineyard, field, and tree crops, as well as commercial nurseries, nursery stock production, and greenhouse operations with soil floors that are not currently operating under WDRs.

### 2.1.8.2 Management Practices

The purpose of this management measure is to reduce NPS pollution of surface and ground waters caused by irrigation. Irrigation water should be applied in a manner that ensures efficient use and distribution of the water and minimizes runoff and soil erosion. Recommended practices include the following:

- Determining and controlling the rate, amount, and timing of irrigation water in a planned and efficient manner. This entails knowing the daily water use of the crop, the water-holding capacity of the soil, and the lower limit of soil moisture for each crop and soil. It is also important to measure the amount of water applied to the field.
- Controlling the manner and application of water to minimize water runoff and soil erosion. USDA NRCS-recommended irrigation systems include microirrigation, sprinklers, surface and subsurface systems, and tailwater recovery systems.
- Designing irrigation water transport systems to eliminate as much water loss as possible.
- Lining irrigation channels to prevent seepage to ground water.
- Using a pipeline and apparatus to convey water to the irrigation system.
- Using a structure that controls the rate and timing of water conveyed to the irrigation system.
- Installing storage reservoirs to keep water for irrigation.
- Managing the drainage water from the irrigation system to control deep percolation, to move tailwater to the reuse system, and to control erosion and adverse impacts on surface and ground waters.
- Using filter strips to capture sediment and pollutants running off fields.
- Use grassed waterways to capture and trap sediment entering receiving waters.
- When irrigation water is conveyed down slopes that increase the velocity, causing erosion, install erosion controls, such as drops, chutes, buried pipelines, or erosion-resistant ditch linings.
- When using a chemigation system, install backflow preventers on wells to minimize the harmful amounts of chemigation waters that discharge from the edge of the field and to control deep



percolation. In cases where chemigation is performed with furrow irrigation systems, a tailwater management system may be needed.

### 2.1.8.3 Information Resources

- **Water Conservation Field Services Program, Demonstration of Innovative Technologies** ([http://www.usbr.gov/uc/progact/watercons/wtr\\_demo.html](http://www.usbr.gov/uc/progact/watercons/wtr_demo.html)): Area programs are supporting local demonstration of projects such as improved water measurement, use of automation and telemetry control, approaches to minimizing canal and ditch seepage, and on-farm irrigation management methods. Activities include (1) assist with research, evaluation, and demonstration; (2) sponsoring conservation demonstration projects and activities; and (3) coordinating financial assistance for joint projects and partnerships with other agencies.
- **The U.S. Bureau of Reclamation's National Irrigation Water Quality Program (NIWQP)** (<http://www.usbr.gov/niwqp/>): The NIWQP is an intra-departmental program that evaluates Department of the Interior irrigation projects, considers drainwater contamination and related impacts on endangered species and migratory birds, assesses legal responsibilities associated with environmental laws, and develops and implements alternatives for remediation.
- **The U.S. Bureau of Reclamation's *Managing Water on the Farm*** ([http://www.usbr.gov/mp/watershare/resources/agriwater/low\\_pressure.html](http://www.usbr.gov/mp/watershare/resources/agriwater/low_pressure.html)): This Web site provides basic information on three types of irrigation systems: gravity flow surface irrigation, pressurized sprinkler irrigation, and low-pressure micro irrigation.
- **WATERIGHT** (<http://www.wateright.org/index.asp>): The WATERIGHT site was developed by the Center for Irrigation Technology at California State University, Fresno, with significant support from the U.S. Bureau of Reclamation. WATERIGHT is designed to be a multifunction, educational resource for irrigation water management. The site is designed for three audiences: homeowners, commercial turf growers, and farmers.
- **University of California, Davis, Cooperative Extension Service, Irrigation Management** (<http://lawr.ucdavis.edu/irrigation/index.htm>): This program is dedicated to the study of irrigation problems and techniques. The Cooperative Extension Service develops and extends research based information that promotes environmentally sound agricultural practices and that improves the efficient utilization of California's valuable water resource.
- **USDA NRCS Irrigation Page** (<http://www.wcc.nrcs.usda.gov/nrcsirrig/>): This Web site provides links to water management models, irrigation components, facts, handbooks and manuals, training, and information sites.
- **University of California Cooperative Extension Service Water Management Series Publications** are available for purchase from the Cooperative Extension Service for \$15 to \$25. Titles include: Agricultural Salinity and Drainage, Drip Irrigation for Row Crops, Irrigation Pumping Plants, Microirrigation of Trees and Vines, Scheduling Irrigations: When and How Much Water to Apply, Surface Irrigation, and Surge Irrigation. The order form and links to brief descriptions of the publications can be found at <http://lawr.ucdavis.edu/irrigation/manuals.htm>.
- **The U.S. Bureau of Reclamation's *A Guidebook for Preparing Agricultural Water Conservation Plans: Achieving Effective Water Management*** (<http://www.usbr.gov/pn/programs/wat/publications/guidemstr.pdf>).
- **California Farm Water Coalition, *The Water Fact Book: California Agriculture and Its Use of Water*** ([http://www.cfwc.com/water\\_facts/fact\\_book.html](http://www.cfwc.com/water_facts/fact_book.html)).

- **The Pacific Northwest Cooperative Agricultural Weather Network, *AgriMet Irrigation Guide*** (<http://www.usbr.gov/pn/agrimet/irrigation.html>).

#### 2.1.8.4 Case Studies

*Water Use Efficiency Pilot Program 2001.* The Yolo County Resource Conservation District undertook a 1-year pilot program funded by the CALFED Water Use Efficiency Program from December 2000 through December 2001. The District was selected for this pilot program because of its history as an innovator in on-farm water quality improvement techniques, especially those employing native perennial grasses, wetland plants, shrubs, and trees.

The District's intent in taking on the pilot program was to initiate a more rigorous analysis of the assumed water quality benefits of practices it has long promoted: especially those of tailwater ponds, sediment traps and winter cover cropping. The actual water quality improvements associated with those conservation techniques had never been rigorously quantified. In light of the changing regulatory climate regarding farm runoff water quality, the information gathered may prove particularly useful for (a) informing regulators of acceptable and measurable water conservation techniques that can be used to meet their goals, and (b) informing farmers and water managers of proven tools that they can employ in their desire to best manage the water under their control.

The District works closely with local farmers and agricultural industry and is familiar with the stresses and realities of agricultural operations and the families who run them. The District is committed to exploring and promoting means of voluntary compliance without direct regulation to enable farmers to continue their business while properly managing public resources such as air, water, and wildlife.

Under this pilot program, tailwater ponds and sediment traps clearly served their function as devices that entrain sediment, especially when properly designed and maintained. Most of the traps and ponds studied provided some nutrient capture during the initial irrigations as well, although that aspect of their function requires further study.

The winter cover crop study also demonstrated both runoff flow attenuation and sediment reduction. Further study of the degree of success relative to planting date (likely the earlier, the better) and cover crop growth stage would help to gauge the most effective application of this technique.

Water use efficiency is compelling for farmers at the very least because of a potential decrease in pumping costs.

Although the District considers the information gathered through the pilot program to be useful to CALFED in its aim to promote locally led, on-farm water use efficiency programs, the pilot program has also provided an excellent opportunity for the District to refine its on-farm monitoring program and understanding of potential collaboration to promote water use efficiency in Yolo County.

*Yolo County Resource Conservation District, Water Quality and Irrigation Ecosystem Management Project.* The overall objective of this grant-funded program was to address both natural resources and stakeholders within the practical realities of farming, water delivery, and county road safety and maintenance. Funded by the SWRCB, with support from RWQCB 5, this project offered an integrated management approach that combined volunteer landowners and agency participation in a working partnership involving innovative practices. Applying these coordinated practices, the Yolo County Resource Conservation District (RCD) worked to improve water quality and biodiversity by targeting and installing tailwater retention basins as well as canal, roadside, and riparian vegetation systems.

Working in the Willow Slough watershed, the Yolo County RDC found that water problems are interrelated and circular. Contaminated with pesticides, sediment, and nutrients, agricultural tailwater runs freely through a degraded biological system where canals, creeks, and roadsides double as agricultural drains. The task was to find and demonstrate farm-friendly, cost-effective, and practical solutions.

This program implemented a set of structural and vegetative solutions in 1995-97, including five vegetated tailwater retention basins, 1 mile of vegetated canal bank, 1 mile of vegetated roadside, and one-quarter mile of riparian revegetation on a local slough. To extend these projects beyond the grant period, RCD staff provided training to local irrigation district canal tenders, farmers, and county road crews to install and maintain these restored areas in the future.

([http://www.yolorcd.org/programs/irrigation\\_ecosystem/irrigatesys.shtml](http://www.yolorcd.org/programs/irrigation_ecosystem/irrigatesys.shtml))

#### **2.1.8.5 References**

USDA. No date. *Electronic Field Office Technical Guide for California*. U.S. Department of Agriculture, Natural Resource Conservation Service. (<http://efotg.nrcs.usda.gov/>)

USEPA. 2002. Chapter 4: Management Measures. In *National Management Measures for the Control of Nonpoint Pollution from Agriculture*. U.S. Environmental Protection Agency, Washington, DC. (<http://www.epa.gov/owow/nps/agmm/>)

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## 2.1.9 Management Measure 1G Education and Outreach

### *Management Measure*

Implement educational programs to provide greater understanding of watersheds, and to raise awareness and increase the use of applicable agricultural management measures and practices where needed to control and prevent adverse impacts on surface and ground waters. Public education, outreach, and training programs should involve user groups and the community.

### 2.1.9.1 Programs

- The California Grazing Academy is a unique and exciting program emphasizing practical application of controlled grazing principles to improve the environment and increase ranch profit. This challenging course consists of a minimum of lecture and a maximum of hands-on experience and learning ([http://ceplacer.ucdavis.edu/Livestock/California\\_Grazing\\_Academy\\_-\\_Low-Stress\\_Livestock\\_Handling\\_School.htm](http://ceplacer.ucdavis.edu/Livestock/California_Grazing_Academy_-_Low-Stress_Livestock_Handling_School.htm)).
- The Pacific Northwest Collaborative Nutrient Management Education Program has as its goal to increase the ability of agricultural professionals to support landowners in sustainable nutrient management decisions that minimize negative impacts of nutrients on the environment and human health (<http://wsare.usu.edu/pro/pr2002/EW00-011.pdf>).
- The Code of Sustainable Wine Growing Practices project organizes information workshops and distributes workbooks to all workshop attendees at no charge. The Wine Institute and the California Association of Winegrape Growers are working with California regional wine associations, vintners, and growers to organize and carry out workshops in each winegrowing region in the State. Regional associations or individual vintner and grower companies or both can host these workshops (<http://www.wineinstitute.org/communications/SustainablePractices/workshops.htm>).
- The University of California Sustainable Agriculture Research and Education Program is a statewide program administered by the university's Agriculture and Natural Resources Department. It has three mandates: administer competitive grants for research on sustainable agriculture practices and systems, develop and distribute information through publications and on-farm demonstrations, and support long-term research in sustainable farming systems on University of California farmlands (<http://www.sarep.ucdavis.edu/grants>).
- Yolo County Total Resource Management/Model Farm Program ([http://www.yolored.org/programs/trm\\_model\\_farms/modelfarm.shtml](http://www.yolored.org/programs/trm_model_farms/modelfarm.shtml)): Through a challenge grant from the U.S. Bureau of Reclamation, the Yolo County Resource Conservation District along with four other conservation districts and the California Association of Resource Conservation Districts worked with regional experts and six local growers to determine what form and impact Total Resource Management can have on Yolo County farms. The District selected its cooperators to represent a diversity of cropping systems and geographical locations within the county, including foothill rangelands, an organic walnut orchard, and high-production field and row crops. In October 2000 the District completed the 6-year project.

### 2.1.9.2 Management Practices

The purpose of this management measure is to implement educational programs to provide greater understanding of watersheds, and to raise awareness and increase the use of applicable agricultural standards and practices to control and prevent adverse impacts on surface and ground waters. Educational materials on agricultural NPS pollution and pollution prevention programs should be developed for the following:

- Activities that cause erosion and sediment loss and the practices that control erosion and sediment on agricultural lands.
- Activities that cause animal waste discharges from storage structures at confined animal facilities and appropriate application of nutrients to cropland.
- Activities that cause excess nutrient runoff into surface water or nutrient leaching into ground water and the measures that can control and prevent runoff.
- Prevention of pesticide runoff into surface water and pesticide leaching into ground water.
- Grazing activities that cause physical disturbance in sensitive areas and the discharge of sediment, animal waste, nutrients, and chemicals to surface and ground waters.
- Irrigation activities that cause NPS pollution of surface waters.

Public education and outreach programs should be developed at the appropriate level for the stakeholder group or audience it is designed to reach, using the following methods to educate and disseminate information to the specified audience:

- Use training programs to teach proper application of agriculture management practices.
- Establish bulletin boards for environmental messages and idea sharing.
- Hand out fact sheets, flyers, and pamphlets on controlling agricultural NPS pollution.
- Develop a handbook for local or regional producers and growers with recommended practices and standards to meet the requirements of the management measures.
- Organize meetings with local stakeholders.
- Develop an “Ag Center” or “one-stop shop” for farmers, growers, and producers to obtain information on NPS pollution prevention techniques, technologies, information resources, and idea exchange.
- Make available a directory of farm advisors, crop advisors, and nutrient management planners for producers and growers to contact for technical advice.
- Work with the local extension service offices and USDA NRCS offices to establish certification and continuing education programs in comprehensive nutrient management planning, grazing, irrigation, and pesticide management.

### 2.1.9.3 Information Resources

- **California Department of Pesticide Regulation, Pest Management Alliance**  
(<http://www.cdpr.ca.gov/docs/empm/alliance/pmagrnts.htm>): California DPR’s Pest Management Alliance program Web site provides links to past and ongoing projects that were completed under

the Pest Management Alliance Program. The program provides funding support to encourage increased implementation of biologically intensive, reduced-risk pest management, and several successful projects are under way that can serve as examples for future pest management projects and innovations.

- **The University of California Sustainable Agriculture Research and Education Program** (<http://www.sarep.ucdavis.edu/>): The Sustainable Agriculture Research and Education Program is a statewide program administered by the university's Agriculture and Natural Resources Department. Its Web site contains newsletters, publications, news releases and other media, educational programs, and funding opportunities related to such topics as crop and livestock production, biologically integrated farming systems (BIFS), organic farming, and local food systems.
- **The University of California Cooperative Extension Service** (<http://ucanr.org/index.cfm>): The UC Cooperative Extension Service Web site offers information about food and nutrition, farming, pest control, natural resources, animal agriculture, gardening, and many other topics. Its publications page contains a variety of practical, research-based educational media such as publications, videos, slide presentations, interactive distance learning, audio recordings, and electronic multimedia. *California Agriculture*, the UC Agriculture and Natural Resources quarterly magazine, can also be accessed here.
- **The Coalition for Urban/Rural Environmental Stewardship (CURES)** (<http://www.curesworks.org/>): The Coalition for Urban/Rural Environmental Stewardship was founded in 1997 to support educational efforts for agricultural and urban communities focusing on the proper and judicious use of pest control products. The publications available from the CURES Web site include information on application stewardship, farm worker safety, ground application timing, and water quality protection.
- **Louisiana State University, Ag Center** ([http://www.lsuagcenter.com/en/environment/conservation/master\\_farmer/index.htm](http://www.lsuagcenter.com/en/environment/conservation/master_farmer/index.htm)): The Master Farmer Program is an effort to demonstrate that agricultural producers can voluntarily reduce the impact that agricultural production has on Louisiana's environment. The Master Farmer Program has three components: environmental stewardship, agricultural production, and farm management/marketing.
- **University of Wisconsin Cooperative State Research, Education, and Extension Service, Best Education Practices Project** (<http://wateroutreach.uwex.edu/>): The University of Wisconsin Cooperative State Research, Education, and Extension Service has initiated the Water Outreach Education project, also known as the Best Education Practices project, to help natural resource management and outreach professionals to choose appropriate education techniques and resources for their water management programs. The Best Education Practices project will work in collaboration with the federal agency clean and safe water partnership and other networks to develop and promote best education practices for water education and to improve access to education resources and strategies. Project activities reflect advice provided by federal agency clean and safe water partners and a national network of water education organizations created and supported by the work of several national organizations over the last decade. Projects have included a 2002 Study of Provider Needs, Model Education Technique, a literature search, Best Education Practices Pilot Web site, and other reference materials related to water outreach education.
- **Ohio State University, Precision Agriculture Team** (<http://precisionag.osu.edu/resources/>): The goal of the Precision Agriculture team is to coordinate and enhance research, teaching, and education and outreach efforts in the area of precision agriculture. This Web site provides access



to a variety of resources related to precision agriculture, such as GIS, remote sensing, and soil sampling methods.

- **USEPA Watershed Academy Web site** (<http://www.epa.gov/watertrain/>): This Web site offers 50 self-paced training modules that represent a basic and broad introduction to the watershed management field. The module themes include introduction/overview, watershed ecology, watershed change, analysis and planning, management practices, and community/social/water law. A module specific to agricultural management practices, called “Agricultural Management Practices for Water Quality Protection,” is available at <http://www.epa.gov/watertrain/agmodule/>.

#### 2.1.9.4 Case Study

*Monterey Bay National Marine Sanctuary.* The Agriculture and Rural Lands Action Plan was developed in 1999 to address agricultural water quality issues related to the sanctuary such as erosion control, nutrient runoff, and persistent pesticides. The plan had several components, including an agriculture industry network, technical information and outreach, education and public relations, regulatory coordination and streamlining, funding mechanisms and incentives, and public lands and rural roads. The technical information and outreach and the education and public relations sections of the plan are as follows:

**Technical Information and Outreach:** Although extensive technical information exists on agricultural techniques and tools to improve water quality, this information is not always readily available or easily usable for growers and ranchers who have many other facets of their business to attend to. The general intent of the strategies in this section of the plan is to make this information more accessible and useful through increased support for existing technical outreach services, development of networks, cross-training of outreach staff, packaging of easily understood information, and conducting onsite follow-up with workshop participants. Recent accomplishments and activities:

- The California NRCS has hired new technical staff for the sanctuary watershed region, including an agronomist, a water quality specialist and a rural roads engineer. Their work includes conducting technical workshops and providing technical assistance for site-specific concerns.
- Partners have begun a compilation of existing technical outreach materials to identify information gaps.
- University of California Cooperative Extension is researching the costs of common conservation measures to demonstrate the costs and benefits involved for landowners.
- Partners are working on the development and promotion of self-monitoring tools so that landowners can track changes over time.

**Education and Public Relations:** There is a need for improved education of the public about agricultural conservation issues, and of public and agricultural groups about watershed issues as a whole. The intent of the strategies in this section of the plan is to enhance public, grower, government agency, and media knowledge about watershed issues, and develop a better recognition and expansion of conservation practices that the agricultural community employs. Accurate, readily understandable information shared among these interest groups should serve as a basis for productive partnerships.

The following are recent accomplishments and activities:

- Regular media columns highlighting watershed issues and agricultural conservation efforts are being developed for local and regional newspapers and journals.

- A marketing firm has been hired to encourage farmer participation and public support for implementation of the plan.
- A Web site is being developed for use by multi-agency field staff, growers, and the public. (<http://www.mbnms.nos.noaa.gov/resourcepro/ag.html>)